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PROFESSIONALISING SOFTWARE DEVELOPMENT IN SCIENTIFIC RESEARCH

BCS society board discussion document

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BCS welcomes the government's commitment to following the science in developing policy responses to the coronavirus pandemic. We particularly welcome the use of computational modelling as one of the key tools in exploring possible outcomes of policy decisions, such as for example investigating which lockdown measures are likely to have the greatest public health benefits.

At the same time we consider that at present the quality of the software implementations of scientific models appear to rely too much on the individual coding practices of the scientists (who are not computer scientists) who develop them, rather than professional software development practices being publicly evidenced against appropriate standards. For example, a recent article¹ in the journal Nature reports that '*Many machine-learning papers fail to perform an adequate set of experiments*', which has led to poor quality research being published. This is also highlighted in a BBC news article² that claimed '*machine learning [is] causing [a] science crisis*', again because some neural networks are being developed that are not following computer engineering best practice. Another recent Nature article³ has called for scientists to "*publicly share both data and code, making it easier for others to attempt to reproduce a paper's findings*".

We believe professional software development standards should be adopted when implementing computational models for conducting scientific research where that research could be relied on by policy makers and which could have critical consequences for society, such as for example healthcare, criminal justice, or climate change, amongst others. The underlying software code should also be open sourced in line with government guidance⁴. We consider that the public benefit of professionalising and using best practice software development in scientific research include the following:

- The ability of different science research groups to share, combine, adapt and build upon software implementations of computational models, no matter whether they are in the same discipline, institution or country.
- The ability of scientists to correctly modify software implementations of computational models in times of crisis as rapidly as possible.
- Facilitating reproducibility of research findings and ensuring high quality research is published in peer reviewed journals.
- Providing reassurance to the public that policy decisions are based on robust evidence of the highest quality.

¹ <https://www.nature.com/articles/d41586-019-02307-y>

² <https://www.bbc.co.uk/news/science-environment-47267081>

³ <https://www.nature.com/articles/d41586-020-01282-z>

⁴ <https://www.gov.uk/government/publications/technology-code-of-practice/technology-code-of-practice#be-open-and-use-open-source>

Actions: Given the seriousness of this issue and the significant consequences of not using relevant best practice and specialists, BCS will approach key stakeholders to discuss how to professionalise software development practice in scientific research. Potential stakeholders to consult with are: the Centre for Data Ethics and Innovation, the Alan Turing Institute, the Safety Critical Systems club, the British Insurance Association, Royal Society, the Royal Academy of Engineering, Cabinet Office, NSHX, UKRI, Public Health England. We also call upon those scientists who are working so hard and doing vitally important work in the current circumstances to engage with the relevant computer science specialists to ensure that they receive all of the benefits that best practice software development can provide to their work.